International Journal of Life Sciences, Biotechnology and Pharma Research Vol. 14, No. 1, January 2025 Online ISSN: 2250-3137
Print ISSN: 2977-0122

DOI: 10.69605/ijlbpr_14.1.2025.113

ORIGINAL RESEARCH

The incidence of complications associated with local Anaesthesia in dentistry

[1]Dr. Ashish Nahar, [2]Dr. Rina Gameti, [3]Dr. Deepti Upadhyay

[1]Associate Professor, Department of Anaesthesiology, American International Institute of Medical Sciences (AIIMS), Bedwas, Udaipur, Rajasthan, India
[2]Tutor, Department of Anaesthesiology, Government Medical College, Vadodara, Gujarat,India
[3]Associate Professor, Department of Dentistry, Autonomous State Medical College, Ghazipur, Uttar Pradesh, India

Corresponding Author
Dr. Deepti Upadhyay
Associate Professor, Department of Dentistry, Autonomous State Medical College, Ghazipur, Uttar Pradesh, India
Email- deeptiup@gmail.com

Received: 27 December, 2024 Accepted: 18 January, 2025 Published: 31 January, 2025

ABSTRACT

Aim : The Purpose of this study was evaluate the risk factors, type and dosage of local anaesthetic applied, type and duration of treatment, and complications associated with the administration of the local anaesthetic. **Method**: There were absolutely no limitations or specific instructions for inclusion of patients in the study with regard to biological data, type and duration of treatment, or type/branch of local anesthetic to be used. Biological data, Risk factors (eg, cardiovascular, pulmonary, hepatic, metabolic, allergic, CNS disease, pregnancy) Daily medication, Type of dental treatment , Duration of dental treatment , Type and dose of applied local anesthetic. Complications (eg, nausea, vomiting, erythema, urticaria, itching, mucosal edema, anaphylactic shock, Other topics (eg, quality of local Anaesthesia). **Result:** 1600 Patient contacted, 1100 (68.8%) volunteered to participate in this study, Women accounted for the majority of dental patients (55.3%). The average values for female patients were: age 39.9 ± 16.8 yr; weight, 63.5 ± 10.7 kg; height, 166 ± 10.7 cm. The average values for male patients were: age, 42.8 ± 16.8 yr; weight, 79.4 ± 13.1 kg; height, 177 ± 9.1 cm. All three values reached statistical significance at $P < 0.0001$ when compared with each other. This study would suggest that today's dental practitioner should be aware that more than 45% of dental patients will have one or more concomitant diseases. **Conclusion:** Dental Anaesthesia clearly proves to be one of the safest anesthetic procedures compared to general Anaesthesia, with an overall incidence of side effects of 7.6-23.3%, and to regional Anaesthesia, with an incidence of 0.2-19.6%. In dentistry can be further reduced if the following aspects are taken into account. An adequate medical history should be routinely obtained for every dental patient. Doses of local anestheticsAnesthetics with low concentrations of epinephrine should be preferred, since this helps to reduce the incidence of sympathomimetic side effects. The concept of a differentiated Anaesthesia that meets the special requirements of the patient (type and duration of the procedure, risk factors) should be always employed.

INTRODUCTION

Local anesthetics are frequently administered in dentistry and thus can be expected to be a major source of drug-related complications in the dental office. It is now possible for the dentist to select a local anesthetic according to duration and type of dental treatment as well as the patient's specific risk factors and preexisting diseases. Thus, this differentiated local Anaesthesia could help to reduce or even prevent side effects associated with dental Anaesthesia. The purpose of this study was to assess the current use of local anesthetics in dental Anaesthesia and associated side effects.[1,2]

The first anesthetic, cocaine, was obtained in 1859 from the coca plant by Albert Niemann and used locally by Carl Koller during an ophthalmic procedure in 1884. Subsequently, Sigmund Freud applied cocaine topically to the tongue and noted a numbing effect. Halsted was the first surgeon to administer a nerve block in the mandible for successful and painless wisdom tooth extraction. Halsted and his students performed nerve blocks experimentally on each other and administered a local anesthetic solution containing cocaine. It has become clear that cocaine is addictive and causes several adverse effects .[3] Unfortunately, there have also been reports of local anesthetic failures during interventions and, in the early years, several cases of systemic intoxication and even death .Dental local Anaesthesia has various purposes. It is most frequently used to prevent pain

DOI: 10.69605/ijlbpr_14.1.2025.113

during dental treatments, which contributes to the well-being of patients and facilitates treatment for the patient and dentist. Dental local Anaesthesia can also have a therapeutic effect, such as temporarily suppressing pain from pulpitis. [4,5]Finally, dental local Anaesthesia can be used as a diagnostic tool to differentiate between dental pain and temporomandibular joint dysfunction. The active substances of dental local anesthetics can be divided into the ester and amide types. Plasma cholinesterase is responsible for the metabolism of ester local anesthetics, and the liver breaks down amide local anesthetics.[6] Local anesthetics block conduction in fibers that transmit nerve impulses by inhibiting sodium ion inflow through ion channels. This inhibition is temporary because specific enzymes inactivate the local anesthetic .[7,8]

As with any invasive procedure, adverse effects can arise after the administration of dental local Anaesthesia . The severity can range from mild and tolerable, such as blanching, to severe and dangerous, such as anaphylactic shock and toxicity . The duration of adverse effects can also be temporary or permanent . General dental practitioners should be aware of the possible adverse effects associated with the administration of dental local Anaesthesia. Knowledge of the pharmacology and toxicology of these agents will result in their intelligent and judicious use. The choice of local anesthetic should be individualized for each patient. The duration of the dental procedure should be weighed against the duration of action of the local anesthetic; a decision should be made as to whether a vasoconstrictor is needed to prolong its action. However, if the duration of numbness is too long, the possibility of self-mutilation must be considered in certain patients (for example, children and the mentally retarded). In other patients with whom postoperative pain is expected, it may be beneficial to administer a long-acting local anesthetic such as bupivacaine for control of postoperative pain.The total dose of local anesthetic and vasoconstrictor must be determined for each patient based upon body weight; the maximal dosages for each agent should be known. Small children or frail individuals will require below average dosages. The use of a vasoconstrictor may constitute the limiting factor to the total number of local anesthetic cartridges that can be administered safely over a given period of time. Certain medical problems, such as cardiovascular system impairments or hyperthyroidism, may influence the choice of anesthetic and the quantity of vasoconstrictor.[9]

An understanding of the physicochemical properties of local anesthetics is also important to a rational process of selection. There are several causes for failure to achieve profound regional Anaesthesia. These include inflammation and/or infection, anatomic variation, intravascular injection, accessory innervation, and deflection of the needle.Inflammation and infection reduce the efficacy of a local anesthetic by reducing its bioavailability. Local anesthetics with low pKa values (for instance, mepivacaine) are the most effective in this clinical situation. Other causes of inadequate regional Anaesthesia are primarily related to technique of administration and can be circumvented by the use of the periodontal ligament injection.

Occasionally, a clinician may be unsuccessful at achieving regional Anaesthesia despite these additional measures. Highly anxious dental patients or patients with a genuine tolerance to local anesthetics normally pose the most problems. Transitional block or threshold block phenomena should also be suspected in these situations. Allowing adequate time for the block to develop or supplementing the block with additional local anesthetic may resolve the condition. Patients who are highly anxious should receive the benefit of a stress-reduction protocol.

Finally, comprehensive knowledge of the toxicology of local anesthetics and vasoconstrictors will enable the dentist to take proper preventive measures, recognize adverse reactions, and manage them properly. For example, amino-amide local anesthetics are metabolized in the liver and thus may be affected by any factor that alters liver function. Hepatic disease, or drugs such as cimetidine or propranolol may prolong the half-life of amino-amide anesthetics and increase their toxicity. A metabolite of lidocaine may produce posttreatment sedation, and a metabolite of prilocaine can produce methemoglobinemia. The systemic effects of local anesthetics manifest as either drug toxicity, psychogenic, or allergic reactions. Proper categorization of an adverse reaction is not only essential to the correct recognition and the proper treatment of the problem, but also prevents mislabeling and future mismanagement of patients.[10]

STUDY MATERIAL AND METHOD

There were absolutely no limitations or specific instructions for inclusion of patients in the study with regard to biological data, type and duration of treatment, or type/branch of local anesthetic to be used. The data used in this study represent only the results from those questions dealing with complications associated with local anesthetics: 1. Biological data (eg, age, sex, weight, size) 2. Risk factors (eg, cardiovascular, pulmonary, hepatic, metabolic, allergic, CNS disease, pregnancy) 3. Daily medication 4. Type of dental treatment (conservative, surgical, prosthetic) 5. Duration of dental treatment (<20 mins , 20-60 min ,60-90 min , >90 mins) . Type and dose of applied local anesthetic ,7. Medication taken by the patient without medical indication prior to dental treatment 8. Complications (eg, nausea, vomiting, erythema, urticaria, itching, mucosal edema, anaphylactic shock, confusion, desorientation, agitation, dizziness, trembling, headache, syncope, seizure, hypotension, hypertension, bradycardia, tachycardia, arrhythmia, cardiac arrest, pectoral

DOI: 10.69605/ijlbpr_14.1.2025.113

angina, local bleeding, dyspnea, asthma attack, bronchospasm) Other topics (eg, quality of local Anaesthesia).

RESULT

Of the 1600 Patient contacted, 1100 (68.8%) volunteered to participate in this study, Women accounted for the majority of dental patients (55.3%). The average values for female patients were: age 39.9 ± 16.8 yr; weight, 63.5 ± 10.7 kg; height, 166 ± 10.7 cm. The average values for male patients were: age, 42.8 ± 16.8 yr; weight, 79.4 ± 13.1 kg; height, 177 ± 9.1 cm. All three values reached statistical significance at $P < 0.0001$ when compared with each other.Of the patients visiting the dental office, 45.9% had one (30.4%) or more (15.5%) risk factors in their medical history. Dentists most often encountered patients with cardiovascular diseases (22.1%), allergies (19.9%), metabolic diseases (10.4%), and pulmonary diseases (5.1%) (Figure 1). Also, 28.4% (773) of all patients were on a daily medication, with 7.9% taking more than two drugs daily. These patients were most frequently medicated with oral contraceptives (18.5%), Pi blocker/ACE inhibitors/Ca-channel blockers (18.4%), thyroid/antithyroid drugs (15.1%), cardiovascular drugs (13.1%), antihypertensive drugs (9.2%), NSAIDS (7.4%), antidiabetic drugs (7.1%), platelet aggregation inhibitors (6.2%), psychopharmaceuticals (5.3%), antiasthmatic drugs (4.4%), anticoagulating drugs (3.6%), diuretics (3.5%), drugs against hyperlipoproteinemia/hypercholesterolemia (3.2%), rheological drugs (2.1%), corticoids for internal use (1.9%), therapeutics against gout (1.8%), drugs against epilepsy (1.4%), and antihypotensive drugs (1.4%). Additionally, 6.0% of all dental patients self-medicated themselves without medical indication with NSAIDS (61.5%), psychopharmaceuticals or sedatives (20.7%), and antibiotics (6.7%) prior to their dental visits. Patients undergoing surgical procedures premedicated themselves in 9.5% of all cases compared to 4.3% of patients undergoing conservative treatment and 3.6% undergoing prosthetic treatment. Patients most often received surgical (36.2%) or conservative (33.8%) treatment. Prosthetic procedures accounted for 24.1%. Of all dental procedures, 46.5% took less than 20 min, and only 9.8% lasted longer than 90 min. Articaine (4%) with epinephrine 1: 200,000 (51.5%) and articaine (4%) with epinephrine 1: 100,000 (38.7%) were the most frequently administered anesthetic solutions. Mepivacaine (3%) was used in only 3.0% and lidocaine (2%) with epinephrine 1: 100,000 in 2.1% of all local Anaesthesias. The average doses patients received were highest for articaine 1: 100,000 (2.9 ± 2.1 ml) and lowest for lidocaine 1: 100,000 (2.3 + 1.5 ml). Mepivacaine was administered with an average dose of 2.5 ± 1.7 ml and articaine 1: 200,000 with an average dose of 2.4 ± 1.6 ml.The general incidence of complications associated with dental local Anaesthesia was 4.5% for all 2731cases. Frequent complications (calculated for all 2731cases) were dizziness (1.3%), tachycardia (1.1%), agitation (1.1%), nausea (0.8%), and tremor (0.7%) (Figure2). Syncopesoccured in 12 cases. Severe complications-one seizure and one bronchospasm-occurred in only 2 of the 2731 cases recorded (0.07%).In the presence of risk factors in the medical history, the incidence of side effects rose to 5.7% ($P = 0.007$, compared to patients without risk factors). The incidences of dizziness, agitation ($P = 0.01$), tremor, local bleeding, and nausea were especially increased (Figure3). In contrast, only 3.5% of the patients without any risk factors developed complications associated with the application of the local anesthetic. In patients suffering from cardiovascular diseases (600 of 2731 cases), higher incidences of tachycardia ($P = 0.003$), dizziness, agitation, and tremor were observed . However, severe complications such as arrhythmia, angina pectoris, and cardiac arrest did not occur at all. Additionally, in patients with cardiovascular diseases, the incidence of complications increased significantly with the duration of the treatment. Whereas during procedures lasting less than 20 min, only 2.9% of these patients developed complications, the incidence increased to 15.0% ($P =0.0012$) for procedures lasting longer than 90 min . The incidence of complications rose to 9.1% ($P = 0.03$) for patients who had premedicated themselves prior to the dental procedure. Dizziness (3.0% vs 1.2%), tachycardia (3.0% vs 0.9%), hypertension (2.4% vs 0.2%), agitation (2.4% vs 1.1%), syncope (1.8% vs 0.4%), nausea (1.8% vs 0.7%), bleeding (1.2% vs 0.4%), and vomiting (1.2% vs 0.1%) were more frequently observed in these patients compared to non-self-medicated patients. Additionally, self-medicated patients received reinjection (28.6%) more often than did non-self-medicated patients (15.2%) ($P = 0.0001$) as well as higher total doses (first injection + reinjection) of local anesthetics (3.4 ml vs 2.9 ml; $P = 0.003$). With regard to the frequency of side effects associated with the local anesthetic applied, lidocaine and articaine 1: 200,000 produced the fewest complications. Lidocaine 1: 100,000 (applied in 56 cases) was not associated with any side effects. Articaine 1: 200,000, applied in 1404 cases, showed minor complications in 3.1%; articaine 1: 100,000, applied in 1057 cases, in 6.1%, and mepivacaine, applied in 83 cases, in 7.2%. For articaine 1: 100,000, higher incidences of tachycardia (1.8% vs 0.5%; $P = 0.001$), agitation (1.4% vs 0.6%; $P = 0.001$), nausea (1.4% vs 0.4%), and tremor(1.0% vs 0.4% $P = 0.001$) were observed than for articaine 1: 200,000 (Figure 4). It could also be shown that articaine was equally administered to patients with and without risk factors and that lidocaine was given more often to patients without risk factors . Of the 83 patients receiving mepivacaine for dental Anaesthesia, 71 had risk factors in their medical histories ($P = 0.001$, compared to articaine). Additionally, there existed only a weak

DOI: 10.69605/ijlbpr_14.1.2025.113

correlation between the patient's body weight and the dose of local anesthetic administered and a similarity to a Gaussian distribution pattern with a maximum at 17 ml can be seen (Pearson correlation coefficient = 0.11 ; regression = 0.0807; P = 0.0001) . The sameis true for patients weighing less than 50 kg (Pearson correlation coefficient = 0.26; regression = 1.2; P = 0.0028).

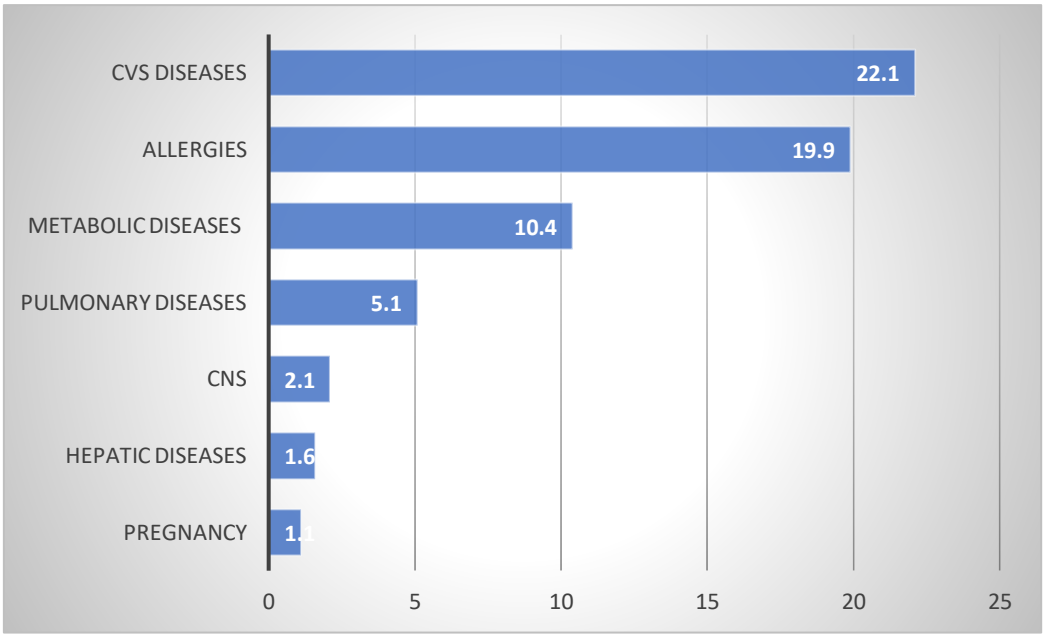

Fig 1: Incidence of risk factors in 2731 cases recorded (%). A patient may exhibit more than one risk factor.

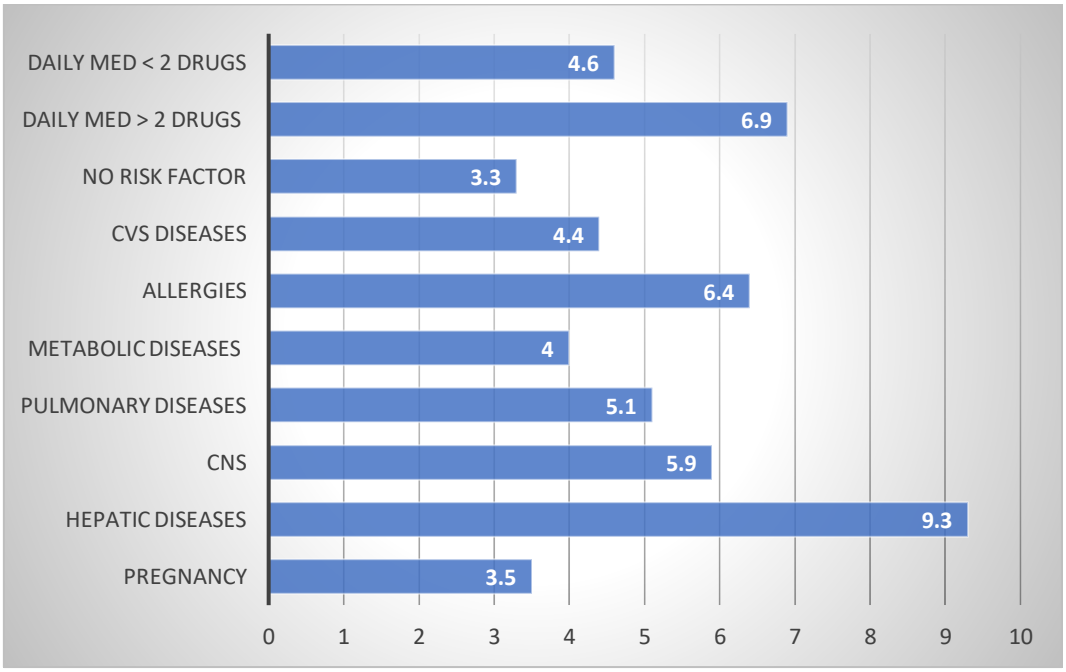

Fig 2: Incidence of complications in all patients depending on preexisting risk factors (single selection) (% of all patients).

DOI: 10.69605/ijlbpr_14.1.2025.113

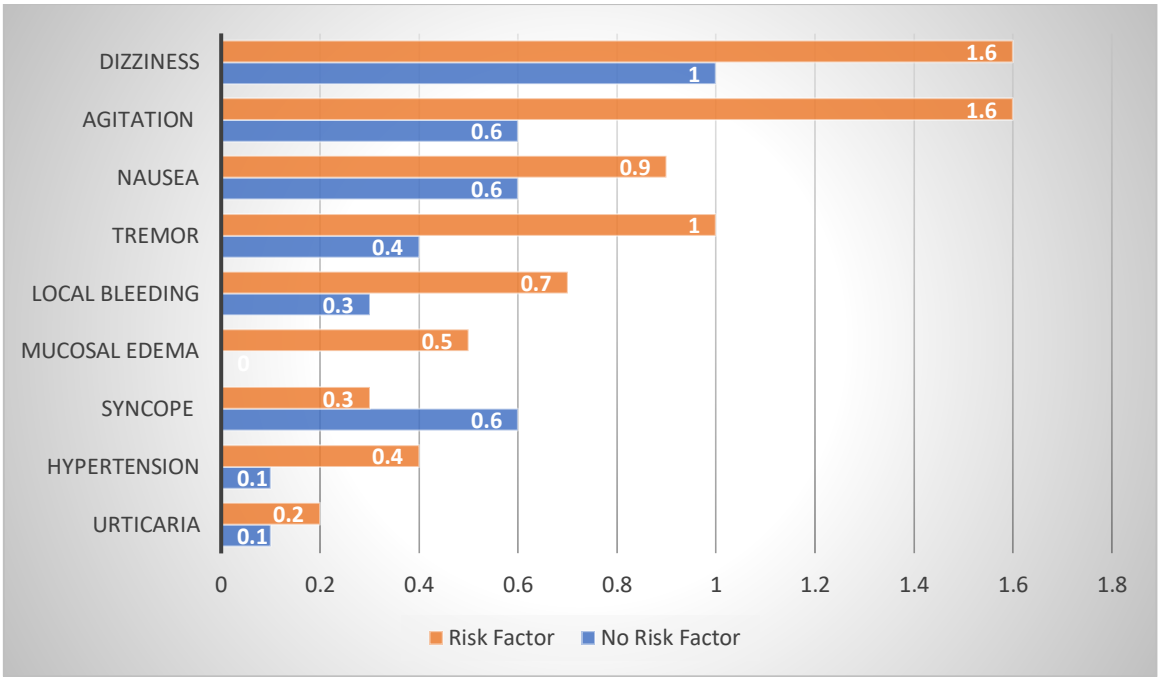

Fig 3: Incidence of specific complications depending on the presence of risk factors compared with the incidence in the absence of any risk factors (% of all patients).

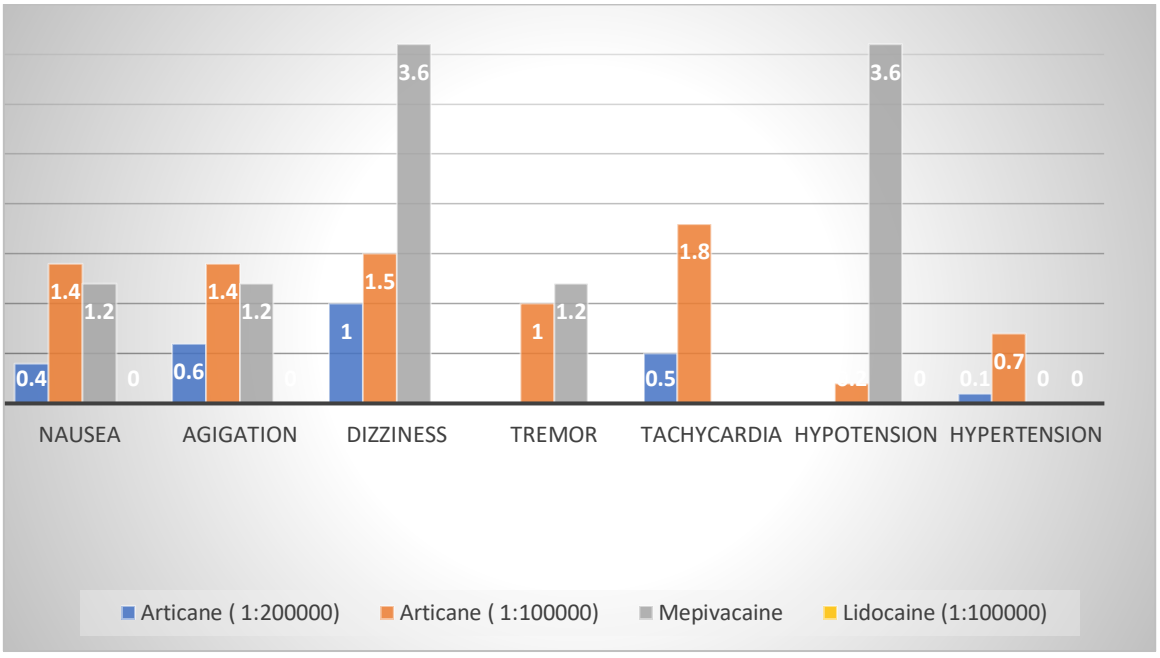

Fig 4: Incidences of specific complications depending on the local anesthetic injected (% of all patients)

DISCUSSION

This study would suggest that today's dental practitioner should be aware that more than 45% of dental patients will have one or more concomitant diseases in their medical histories and that about 20% of all patients will suffer from cardiovascular diseases or allergies. Severe side effects (one bronchospasm, one seizure). occurred in 2 of 2731 cases reported (0.07%), which is ever, taking a medical history is not part of the daily comparable to the incidence of 0.05% of severe com- routine.[11] According to a study performed by Jakobs, plications in general Anaesthesia. The overall incidence only 12.9% of 541 dentists surveyed always get a medof mostly minor side effects associated with dental and medicalical history prior to treatment, and 14.5% stated that Anaesthesia was 4.5% and thus much lower than those of they had never taken a patient's medical history. Thus, reports on incidences of complications associated with it is essential for dentists to take a medical history in general (7.60/o-23.2%) and regional Anaesthesia (0.20/o- order to reduce or even prevent side effects associated 19.6%).71o Side effects were observed in 5.7% of risk with dental

DOI: 10.69605/ijlbpr_14.1.2025.113

Anaesthesia, because this enables the dentist patients receiving local dental Anaesthesia, compared to to apply a differentiated Anaesthesia that meets the speonly 3.5% of nonrisk patients.[12]The lowest incidence account that 61.5% of the self-medicated patients will of complications being associated with local dental anaesthesia have taken NSAIDS or aspirin, these results are super, it proves to be the safest anesthetic procedure ported by the findings of Reinhart et al , who showed compared to general or regional Anaesthesia. that people taking analgesics, NSAIDS, and antibiotics Nevertheless, this patient profile and the incidence of failed significantly more often to receive a sufficient side effects associated with dental Anaesthesia underline depth of Anaesthesia. Therefore, the increased incidence the necessity for taking an adequate medical history prior of complications for self-medicated patients might be or to the dental procedure, by far the simplest and most partially due to the fact that they receive higher total efficient method for the detection of risk factors. Additionally, it can be assumed that these patients are more afraid of dental interventions and may thus be more likely to show psychogenic .[13]It has also been shown that the higher concentration of epinephrine in the local anesthetic solution of articaine 1: 100,000 compared to 1: 200,000 is the major source of sympathomimetic side effects. In Study, also observed an increase in heart rate of more than 20 beats per minute in 4.1% of their patients, with a higher incidence of tachycardias for local anesthetic solutions containing 10 ,ug/ml (1: 100,000)of epinephrine. Additionally, it has been definitely shown that the increase in plasma catecholamine levels observed after dental Anaesthesia with epinephrine is mainly due tothe exogenously applied epinephrine. Thus, it should be investigated whether vasoconstrictor associated complications could be further reduced if local anesthetics with lowest possible concentrations of epinephrine were routinely used. This is especially true since no statistically significant differences in onset and duration of Anaesthesia could be found between articaine: 200,000 and lidocaine 1: 80,000.17

The higher incidence of complications observed with the application of mepivacaine is most likely due to the fact that mepivacaine is preferredly applied to risk patients who already exhibit an increased overall incidence of complications. Mepivacaine is still the local anesthetic of choice for patients with absolute contraindications to vasocontrictors.5 Similarily, the low incidence of side effects associated with lidocaine can be explained by the fact that it is given mainly to patientswithout any risk factors and that it is given in much lower doses than articaine or mepivacaine. Additionally, it was only administered to 56 patients, compared to 2461 applications of articaine. Therefore, in order to draw valid conclusions about the incidence of side effects associated with lidocaine compared with those associated with articaine, a patient group of >1000would be necessary. No severe complications were observed in 600 patients with cardiovascular diseases, and it can be concluded that these patients can be safely treated under local Anaesthesia.

It can be assumed that evaluating every patient for risk factors and determining doses of local anesthetics strictly according to body weight will help to further reduce the incidence of dental-Anaesthesia-associated complications.

CONCLUSION

The overall incidence of complications associated with local dental Anaesthesia was 3.5% for non risk patients and 5.7% for patients with risk factors. Thus, dental Anaesthesia clearly proves to be one of the safest anesthetic procedures compared to general Anaesthesia, with an overall incidence of side effects of 7.6-23.3%, and to regional Anaesthesia, with an incidence of 0.2-19.6%. Severe complications occurred in only 0.07% (2 cases out of 2731 reported) of patients, which is comparable to the incidence of 0.05% of severe complications associated with general Anaesthesia. However, the vast majority of side effects were minor, were transient in nature, and did not require treatment. In dentistry can be further reduced if the following aspects are taken into account. An adequate medical history should be routinely obtained for every dental patient. Doses of local anesthetics should be always strictly. determined according to body weight, and maximum recommended dosages should be respected. Anesthetics with low concentrations of epinephrine should be preferred, since this helps to reduce the incidence of sympathomimetic side effects. The concept of a differentiated Anaesthesia that meets the special requirements of the patient (type and duration of the procedure, risk factors) should be always employed.

REFERENCES

1. Köller C. The use of cocaine for producing anaesthesia of the eye [translated and reprinted]. Lancet 1884; II: 990–2
2. Mattison JB. Cocaine poisoning. Med Surg Rep 1891; 60: 645–50
3. Bier A. Experiments regarding cocainization of the spinal cord [in German]. ZietschrChir 1899; 51: 361–9
4. Kennedy F, Effron AS, Perry G. The grave spinal cord paralysis caused by spinal anesthesia. SurgGynecolObstet 1950; 91: 385–98
5. The Wooley and Roe case. Anaesthesia 1954; 9: 249–70
6. Finucane BT, Finegan BA. The attitude of the general public towards regional anesthesia. Int Monit 1997; 9(3): 74
7. Cathelin F, Sicard J. Discovery of epidural anesthesia [translated and published in classical file]. SurvAnesthesiol 1979; 23: 271–3
8. Report on confidential inquiries into maternal deaths in the United Kingdom 1994–96. London: Her Majesty's Stationary Office, 1998

DOI: 10.69605/ijlbpr_14.1.2025.113

9. Snyder SH. Opiate receptors in the brain. N Engl J Med 1977; 296: 266–71
10. Horlocker T. Peripheral nerve blocks-regional anesthesia for the new millennium. RegAnesth Pain Med 1998; 23: 237–40 , Adriani J. Reactions to local anesthetics. JAMA 1966; 196: 405
11. Brown DT, Beamish D, Wildsmith JAW. Allergic reactions to an amide local anaesthetic. Br J Anaesth 1981; 53: 435–7
12. Jakobs W: The status of dental anesthesia in Germany. AnesthProg 1989;36:210-212.
13. Reinhart E, Reuther J, Schargus G, Lipp M, Then U: Verschiedene Einflul3gr6olen auf die Lokalanasthesiewirkung von Articain. DtschZahnarztl Z 1991;46:819-821.